Method: Zooplankton fecal pellet production

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Brief description of protocol and relation to export pathways:
Sinking of zooplankton fecal pellets is one of the five export pathways. We will perform live fecal pellet production experiments on dominant species and whole community size fractions to provide measurements of zooplankton contribution to fecal pellet production during each ecosystem state sampled. These will be scaled to community level export using the biomass measures, as well as species identification and size fractionated biomass made with the MOCNESS.

Animals for live experiments are collected within the epipelagic zone from below the chlorophyll max to the surface, using a 1-m diameter ring net with a non-filtering cod end and slow retrieval rate. Experiments are performed on-board at *in situ* mixed layer temperature, during night and day, in unfiltered surface seawater using both a mixed size-fractionated zooplankton community (Butler & Dam 1994, Urban-Rich et al. 1999) and numerically important taxa (Urban-Rich et al. 1999, 2001; Wexels-Riser et al. 2001).

Fecal pellet production by each size fraction (0.2-0.5, 0.5-1, 1-2, 2-5, and >5 mm) of the mixed zooplankton community is measured using sets of two large (~3.8 liter) containers with a screen insert in the bottom of the inner container (Butler & Dam 1994). The screen allows pellets to be collected in the outer container, but keeps animals separated from their pellets to prevent pellet consumption. Mixed animals from the tow are size-fractionated live and placed in ambient water in the nested containers and incubated for 4-6 hours. The screen-bottom container is lifted (removing animals) and animals are saved for enumeration and biomass measurements. Fecal pellets collected in the outer container are rinsed, counted, and concentrated onto combusted GF/F filters for POC/PON analysis. For pellet production by abundant species from representative size fractions, a suspended cylindrical insert containing animals is capped at both ends with 200 μm mesh (or larger mesh for larger size classes) and placed into 1-liter experimental bottles containing surface seawater and incubated for 4-6 hours. At the end of the experiment the insert containing animals is removed, and water in the outer jar poured through a 30 μm sieve to collect fecal pellets. Animals and pellets are processed as above. Fecal pellet POC/PON production rates are combined with zooplankton weight measurements from each experimental incubator/ bottle to calculate weight-specific fecal pellet POC/PON production rates for the community and within size fractions. Occasionally, fecal pellets of abundant single species of interest (e.g., *Neocalanus* spp., *Salpa fusiformis*) are collected in separate 'bulk' incubations, to calculate their POC/PON content and better determine their contribution to export.

Other contributing protocols: MOCNESS abundance and biomass sampling to scale individual fecal pellet production experiments to community export.

Uncertainties and quality control concerns: Physiological effect of net capture and incubation. When scaling – the effects of zooplankton patchiness and variation in species physiology.

Data products originating with this method:

Parameter	Units

Fecal pellet production zooplankton^{-1*}	mg-C (mg body C or dry weight)$^{-1}$ d^{-1}
Fecal pellet production zooplankton^{-1*}	mg-N (mg body N or dry weight)$^{-1}$ d^{-1}
Zooplankton community fecal pellet production	mg-C or mg-N m^{-3} d^{-1}
Zooplankton community fecal pellet production in euphotic zone	mg-C or mg-N m^{-2} d^{-1}

* Each to be reported separately for each dominant species

Key method references

Butler M, Dam HG (1994) Production rates and characteristics of fecal pellets of the copepod Acartia tonsa under simulated phytoplankton bloom conditions: Implications for vertical fluxes. Marine Ecology Progress Series 114, 81-91

Urban-Rich J, Nordby E, Andreassen IJ, Wassmann P (1999) Contribution by mesozooplankton fecal pellets to the carbon flux on Nordvestbanken, north Norwegian shelf in 1994. Sarsia 84, 253-264.

Urban-Rich J (2001) Seston effects on faecal pellet carbon concentrations from a mixed community of copepods in Balsfjord, Norway, and the Antarctic Polar Front. ICES Journal of Marine Science 58, 700-710.

Wexels Riser C, Wassmann P, Olli K, Arashkevich E (2001) Production, retention and export of zooplankton faecal pellets on and off the Iberian shelf, north-west Spain. Progress in Oceanography 51, 423-441.